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RESEARCH ARTICLE

A RARE ORIGIN OF THE INTERNAL THORACIC ARTERY ON THE LEFT THYRO-CERVICAL TRUNK

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ABSTRACT

Introduction*:* The internal thoracic artery is known for its anatomical variations and their clinical implications. It has important anatomical characteristics that make it an excellent arterial graft for myocardial vascularization. However, data from the literature report variations regarding the origin, course, and termination of the internal thoracic artery. Through this dissection work we wanted to report a rare origin of the left internal thoracic artery directly from the thyrocervical trunk, instead of its usual subclavian origin. ***Material and methods:*** The dissected patient was a 64-year-old subject with no history of cervical region surgery or previous deformity. The cadaver showed no asymmetry about the shoulders or the lateral cervical regions, it had been preserved in a non-formaldehyde solution. Initially, on the subject in supine position, the lateral triangle of the neck was approached and a cleidectomy was performed. The subclavian artery and its collaterals were dissected, identified, and marked. The collateral branches of the subclavian artery were injected with a solution made from a mixture of gelatin, methylene blue and iron powder. Dissection of the subclavian artery and its collateral branches was then continued until their course was fully exposed. ***Results****:* On the course of the left subclavian artery and after the left vertebral artery, we found a thyrocervical trunk giving rise to 4 classic terminal branches, among which an oblique left internal thoracic artery due to its more lateral birth than d 'habit. ***Discussion and Conclusion:*** The left internal thoracic artery is the first choice in coronary bypass surgery because of the permeability of the graft. However, an abnormal origin of the internal thoracic artery on the thyrocervical trunk and a modification of its proximal course, can firstly increase the risk of vascular lesions during different invasive procedures of the lateral triangle of the neck. secondly, they can have circulatory consequences in the vertebrobasilar arterial system. It is important for the practitioner to resort to a morphological study of this region to expose and prevent this anatomical variation.

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INTRODUCTION

The internal thoracic artery is the second branch of the subclavian artery arising after the vertebral artery, it supplies a portion of the anterior thoracic and abdominal walls. It originates from the underside of the subclavian artery and runs downwards and a little inwards, on the anterior side of the pleural dome and behind the subclavian vein (Henriquez-Pino *et al*., 1997; Sajja *et al*., 2015). The phrenic nerve crosses it passing in front and inside of it. The internal thoracic artery is known for its anatomical variations and their clinical implications. This artery is widely used as a graft in coronary bypass surgery (Cameron *et al*., 1995; Lytle *et al*., 2004).

The internal thoracic artery has important anatomical characteristics: an intrathoracic route and proximity to the heart, good permeability and an excellent long-term survival rate, good living comfort in the postoperative period. These characteristics make it an excellent arterial graft for myocardial vascularization. However, data from the literature report variations regarding the origin, course, and termination of the internal thoracic artery(Henriquez-Pino *et al*., 1997; Sajja *et al*., 2015; Cameron *et al*., 1995; Vorster *et al*., 1998). Through this dissection work we wanted to report a rare origin of the internal thoracic artery directly from the thyrocervical trunk, instead of its usual subclavian origin.

CASE REPORT

The dissected patient is a 64-year-old male subject, with no history of cervical region surgery or previous deformity. The cadaver showed no asymmetry regarding the shoulders or the lateral cervical regions, it had been fixed in a non-formaldehyde solution. The cadaver was first placed in supine position and the posterior triangle (lateral cervical region) was approached to remove the clavicle.

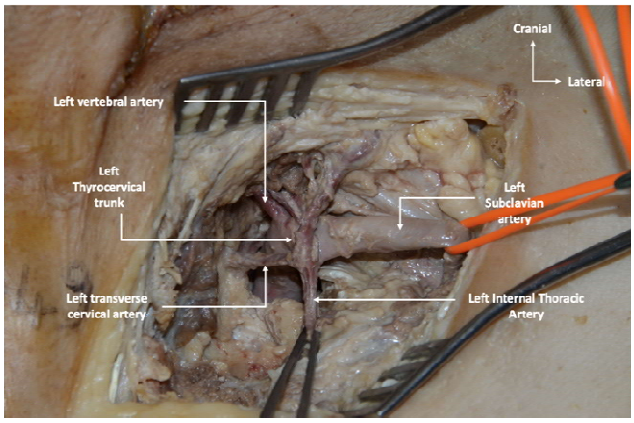

Figure 1. Dissection of the left subclavian artery

The subclavian artery and its collateral branches were dissected, identified, and marked. The collateral branches of the subclavian artery were injected with a solution containing a mixture of gelatin, methylene blue and iron powder. The cadaver was then refrozen for 24 hours, then brought back to room temperature for a second time. The dissection of the subclavian artery collateral branches was conducted until complete exposure of their path. Our dissection showed no left internal thoracic artery at the lower border of the origin of the subclavian artery as typically described in the literature. On the course of the left subclavian artery, we rather found following a left vertebral artery a thyro-cervical trunk giving rise to 4 classic terminal branches among which an oblique left internal thoracic artery because of its more lateral birth than usual.

DISCUSSION

An abnormal origin of the internal thoracic artery has already been documented in the literature. Unilateral or bilateral origin of the internal thoracic artery from the lateral segments of the subclavian arteries was mentioned in at least 1% of the cases studied (Vorster *et al*., 1998; Pietrasik *et al*., 1999). Moreover, the possible common origin of the internal thoracic artery and the branches of the thyrocervical trunk is clinically underestimated. Does the common origin of the internal thoracic artery of the thyrocervical trunk affect the comfort of practitioners and the survival of patients in the context of coronary bypass surgery? The internal thoracic artery arises from the antero-inferior part of the subclavian artery, approximately at the same level as the thyrocervical trunk (Henriquez-Pino *et al*., 1997; Sajja *et al*., 2015; Cameron *et al*., 1995). In the literature, it appears that in 79% of cases the internal thoracic artery arises from the first segment of the subclavian artery. It was particularly indicated that in 2.6 and in 16% of cases the internal thoracic artery had a common origin with the suprascapular artery, and in 5% of cases a common origin with the suprascapular and transverse neck arteries, in 0.5% of cases a common origin with the transverse neck artery alone, in 4% of cases a common origin with the ascending cervical and inferior thyroid arteries, and in only 0.1% of cases the internal thoracic artery presented a common origin with the transverse cervical and suprascapular arteries (Hefel *et al*., 1995; Vesely *et al*., 2007; Owens *et al*., 1994; Salmon, 1936). In addition, the left internal thoracic artery had a common origin with the suprascapular and inferior thyroid arteries in 2% of cases, and with the ascending cervical and suprascapular arteries in 1% of cases (Owens *et al*., 1994; Salmon, 1936).

Also, in 1% of cases the left internal thoracic artery originated in common with the ascending cervical artery, and in 1 to 7.4% of cases it originated jointly with the 4 branches of the thyrocervical trunk (Vesely *et al*., 2007; Owens *et al*., 1994; Salmon, 1936).Daseler *et al* reported that the left internal thoracic artery originated from the 2nd segment of the subclavian artery, axillary artery, and superior intercostal artery respectively in 2.9%, 0.3%, and 0.3% of cases (Daseler *et al*., 1959). Furthermore, Henriquez-Pino observed that the internal thoracic artery originated as a single trunk of the subclavian artery in 95% of cases (Henriquez-Pino *et al*., 1997). Lischkareported a significant 10% incidence of left internal thoracic artery abnormal origin, while the right internal thoracic artery had the same origin in only 2% of cases (Lischka *et al*., 1982). They also reported that in some cases the internal thoracic artery could give off arterial branches usually attributed to the thyrocervical trunk. Puri *et al* reported that the right internal thoracic artery originated in common with the thyrocervical trunk in 4% of cases, and Wisniewski *et al* in 6.2% of cases (Puri *et al*., 2007; Wisniewski *et al*., 2004). Uemura also observed that the internal thoracic artery could arise from the thyrocervical trunk in 11.8% of the 110 cases in which the subclavian artery passed behind the anterior scalene muscle (Uemura *et al*., 2010). Babu (Babu, 2010)reports a rare origin of the internal thoracic artery from the left thyrocervical trunk, found in one of his 100 dissected cadavers (1%). Daseler (Daseler *et al*., 1959) found this variant in 6 cases of 769 dissected arteries (0.78%). Krenchowiecki (Krenchowiecki *et al*., 1973) demonstrated it in one out of 200 arteries (0.5%). It appears in our work that the internal thoracic artery arises directly from the left thyrocervical trunk at the same time as 3 other terminal branches. It appears that this internal thoracic appears very oblique in its initial portion because of its more lateral birth than usual. The abnormalities found in the ramifications of the subclavian artery and the thyrocervical trunk can be explained by the embryological development of this region. The 2 factors that influence the development of these branches are represented by the ability of the blood to follow the longitudinal channels which offer the least resistance, and by the tension on the vessels resulting from the caudal displacement of the heart and the aorta. Congdon in describing the development of the subclavian arteries from the 7th segmental dorsal arteries, found that the tension on the distal portion of the right aortic arch causes this part of the aortic arch as well as the 4th segmental dorsal artery to form the proximal part of the right subclavian artery (Congdon, 1922). Thus, with the failure of the distal part of the 7th segmental dorsal artery to obliterate, there is a degeneration of the proximal part. This will result in abnormal origins of the right subclavian artery from the aortic arch or the descending aorta. The internal thoracic arteries develop from the longitudinal arterial ducts of the intersegmental anastomoses. Due to the caudal displacement of the aorta, the proximal portions of these segmental arteries are exposed to longitudinal tension and strain which will retard and restrict blood flow. This phenomenon can lead to abnormal connections between the longitudinal ducts (internal thoracic arteries and vertebral arteries) and the subclavian artery or the aorta. Henriquez-Pino and his team worked on 100 fresh adult cadavers to determine the origin of the internal thoracic artery and its relationship to the phrenic nerve, the presence of lateral costal branches, as well as the termination of the internal thoracic artery (Henriquez-Pino *et al*., 1997). It appears that the internal thoracic artery is present in all subjects. The left internal thoracic artery originated directly from the subclavian artery in 70% of cases, and from a common trunk with the other arteries in 30% of cases. In 95% of cases the right internal thoracic artery originated directly from the subclavian artery, and in 5% of cases from a common trunk with the other arteries. The left internal thoracic artery originated at the level of the first part of the subclavian artery in 92% of cases, in 7% of cases at the level of the 2nd part, and in 1% of cases at the level of the 3rd part. Concerning the right internal thoracic artery, it was born respectively in 96% and 4% of the cases at the level of the first and the 2nd portion of the subclavian artery. In none of the cases was the right internal thoracic artery found at the level of the 3rd portion of the subclavian artery. There is an embryological explanation for the anomalies of implantation and course of the internal thoracic artery (Kamina, 2006; Stojanovska *et al*., 2012).

At the end of the 3rd week of intrauterine life, the small lateral intersegmental arteries arise from the dorsal aorta through different sacral levels and grow into the spaces between the young somites. These intersegmental arteries all lie at right angles to the longitudinal axis of the embryo. These now transverse arteries will connect to each other in certain places because of longitudinal anastomotic chains. The vertebral artery and the other branches of the subclavian artery will develop from these longitudinal anastomoses between the intersegmental arteries in the cervical and thoracic regions. During their development most of the original connections of the intersegmental arteries with the dorsal aorta will disappear. Abnormalities in the development of blood vessels are very common during embryonic life. These abnormalities may result from unusual development of the original vascular plexuses, persistence of vessels which would normally obliterate, disappearance of vessels which would normally persist, incomplete development, or fusion of usually separate portions (Kamina, 2006; Stojanovska *et al*., 2012). Knowledge of the anatomical variations of the vertebral artery, thyrocervical trunk and internal thoracic artery is very important during head, neck, and thorax surgical procedures. Any surgery performed in the deep region of the neck and at the level of the cervical spine can be complicated by an accidental lesion of the vertebral artery, in the event of anatomical variations (Stojanovska *et al*., 2012). The left internal thoracic artery is the first choice in coronary bypass surgery because of the permeability of the graft. But an anatomical variation such as that described by Zhang can be at the origin of the failure of a coronary bypass, because of the presence of the common trunk constituted by the internal thoracic artery and the thyrocervical trunk. In theory, this variation can affect blood flow in the vertebrobasilar arterial system and cause cerebrovascular insufficiency due to a diversion of flow to the internal thoracic artery and the thyrocervical trunk (Zhang *et al*., 2020).

CONCLUSION

An abnormal origin of the internal thoracic artery on the thyrocervical trunk and a modification of its proximal course may increase the risk of vascular injury during various invasive procedures of the lateral triangle of the neck such as central venous catheterization, subclavian hemodialysis, or loco-regional anesthetic blocks. It is important for the practitioner to resort to a radiological study of this region to expose these anatomical variations.

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Conflict of Interest: The authors declare that they have no conflict of interest regarding this study

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